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EXAMINER

INGHAM, JOHN C

ART UNIT

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/561,729	Applicant(s) KLIPSTEIN, PHILIP	
	Examiner JOHN C. INGHAM	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 September 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 33-37, 39-52 and 55-73 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 33-37, 39-44, 46-52, 55-67, 69 and 71-73 is/are rejected.
- 7) ☒ Claim(s) 45, 68 and 70 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 22 December 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>9/24/07</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims **33-37, 39-42, 44, 46, 48, 50-52, 56-58, 60-67, 69 and 71-73** are rejected under 35 U.S.C. 103(a) as being unpatentable over Taylor (US 6,803,557, previously cited) and Elliot (US 5,016,073, newly cited).

3. Regarding claim **33**, Taylor discloses in Fig 1 a photo-detector comprising a first junction formed by an n-type photon absorbing material layer (16) of a certain energy bandgap and an n-type middle barrier layer (16 at interface 15), and a second heterojunction, formed by said n-type middle barrier layer and a p-type contact layer (14, see Fig 15B), the layer materials being selected such that the energy bandgap of the photon absorbing layer is narrower than that of said middle barrier layer (Fig 2, gap at interface 15 is wider than gap deeper within photon absorbing layer 16), the first and second heterojunction being thus configured.

4. Taylor does not specify wherein the n-type photon absorbing material (16) and the n-type middle barrier layer form a heterojunction of different materials. Instead Taylor illustrates an homostructure of layers defined by different dopant concentrations in either gradient or stepwise concentrations (e.g. Figs 2, 7, 8A).

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5. Elliot discloses in a similar device that a homostructure of semiconductor material layers with different doping concentrations (e.g. the homostructure of Taylor) function in similar ways to different semiconductor materials in a heterostructure (col 5 ln 15-20).

Therefore all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination would have yielded predictable results to one of ordinary skill in the art at the time of invention. See Supreme Court Decision in *KSR International Co. v. Teleflex Inc.*, 550 U.S. --, 82 USPQ2d 1385 (2007).

6. The language “operable to prevent creation of a depletion region in said photon absorbing layer when a bias voltage is applied across the heterostructure such that a tunnel current of electrons from the contact layer to the photon absorbing layer is less than a dark current in the photo-detector and the dark current from the photon absorbing layer to the barrier layer is essentially diffusion limited, thus reducing GR noise of the photo-detector” describes an intended use of the photo-detector. Intended use and other types of functional language must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. In re Casey, 152 USPQ 235 (CCPA 1967); In re Otto, 136 USPQ 458, 459 (CCPA 1963). In this case the device taught by Taylor and Elliot, having a similar structure to that claimed, is capable of performing the intended use.

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7. Regarding claim **50**, Taylor discloses in Fig 10A the limitations discussed with regards to claim 33, and further that the photo-detector may have reversed dopant types, forming an n-type contact and p-type barrier and photon absorbing layer as claimed in claim 50 (col 5 ln 32-36, col 8 ln 3-13). Elliot teaches that a homostructure of semiconductor material layers with different doping concentrations (e.g. the homostructure of Taylor) functions in a similar way to different semiconductor materials in a heterostructure.

8. The language “operable to prevent creation of a depletion region in said photon absorbing layer when a bias voltage is applied across the heterostructure such that a tunnel current of electrons from the contact layer to the photon absorbing layer is less than a dark current in the photo-detector and the dark current from the photon absorbing layer to the barrier layer is essentially diffusion limited, thus reducing GR noise of the photo-detector” describes an intended use of the photo-detector. Intended use and other types of functional language must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. In re Casey, 152 USPQ 235 (CCPA 1967); In re Otto, 136 USPQ 458, 459 (CCPA 1963). In this case the device taught by Taylor and Elliot, having a similar structure to that claimed, is capable of performing the intended use.

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9. Regarding claims **34 and 72**, Taylor discloses in a photo-detector according to claims 33 and 50 wherein said layer materials are selected such that the middle barrier layer has an energy bandgap (Fig 2 bandgap at interface of layers 14 and 16) at least twice that of the photon absorbing layer (bandgap at far left side of Fig 2). The language, "wherein under flat band conditions the valence band edge of the contact layer lies below its own conduction band edge, or below the conduction band edge of the barrier layer, by at least twice the bandgap energy of the photon absorbing layer" describes an intended use of the photo-detector.

10. Regarding claims **35 and 51**, Taylor discloses a photo-detector according to claim 33, with a photon absorbing layer thickness of 10 μm and a doping (either n type or p type) of $1 \times 10^{14} \text{ cm}^{-3}$.

11. Regarding claim **36**, Taylor discloses the detector or claim 33, but does not specify wherein the middle barrier layer has a thickness of between 0.05 and 1 μm . Instead Taylor recites that the middle barrier layer has a thickness of 2 μm .

12. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to use the teachings of Taylor and realize a thickness of 1 μm since the claimed thickness is close enough that it is expected to have the same property. In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists (In re Wertheim , 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff , 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990)). Similarly, a prima facie case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have

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expected them to have the same properties (Titanium Metals Corporation of America v. Banner , 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985); See MPEP 2144.05).

13. Regarding claims **37 and 52**, Taylor discloses the photo-detector according to claims 33 and 50 wherein the barrier layer is doped n-type (3×10^{14} , col 6 ln 42), and a p-n junction is formed between said barrier layer and a p-type contact layer having a doping of 1×10^{18} (col 6 ln 28). Taylor also discloses that the dopant types may be opposite (col 8 ln 3-13).

14. Regarding claims **39 and 42**, Taylor discloses a photo-detector according to claims 33 and 34, wherein the photon absorbing layer is an $\text{In}_{1-x}\text{Al}_x\text{Sb}$ alloy (col 8 ln 33).

15. Regarding claim **40**, Taylor discloses a photo-detector according to claim 33 wherein the contact layer is an $\text{In}_{1-x}\text{Al}_x\text{Sb}$ alloy (col 8 ln 33).

16. Regarding claim **41**, Taylor discloses a photo-detector according to claim 33 wherein the middle barrier layer is an $\text{In}_{1-x}\text{Al}_x\text{Sb}$ alloy (col 8 ln 33).

17. Regarding claim **44**, Taylor discloses a photo-detector according to claim 34 wherein the contact layer is GaSb (col 8 ln 34).

18. Regarding claim **46**, Taylor discloses a photo-detector according to claim 34 wherein the middle barrier layer is a $\text{Ga}_{1-x}\text{Al}_x\text{Sb}_{1-y}\text{As}_y$ alloy (col 8 ln 34).

19. Regarding claims **48 and 56**, Taylor discloses in Fig 5 a photo-detector comprising stacked detector sub-units (30A) as in claims 33 and 42 in which each detector sub-unit has a different cut-off wavelength (col 9 ln 6) and in which each detector sub-unit is separated from its neighboring sub-unit by a p-type GaSb layer (18, col 8 ln 28) to which an external contact (24) is made.

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20. Regarding claim **57**, Taylor discloses an array of detectors (Fig 5) in which each detector is as in claim 33, and is connected to a silicon readout circuit by an indium bump (22A, 22B).

21. Regarding claims **58 and 60**, Taylor discloses in Fig 5 an array of detectors in which each detector is sensitive to more than one wavelength band as in claims 48 or 56, and in which each detector is connected to a silicon readout circuit using one indium bump (22A).

22. Regarding claims **61 and 64**, Taylor discloses a photo-detector according to claims 33 and 50, wherein one or more mesa structures (Fig 5 item 30A) are etched through the uppermost layer (20) to a depth suitable for electrical isolation.

23. Regarding claims **62 and 65**, Taylor discloses a photo-detector according to claims 61 and 64, wherein a dielectric layer is applied (Fig 15B passivation item) and has openings to allow the application of metal contacts (22). The language “in which the surfaces of each mesa structure exposed by the etch treatment undergo a chemical treatment” describes a product by process limitation. See MPEP 2113. “[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process.” *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

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24. Regarding claims **63 and 66**, Taylor discloses a photo-detector according to claims 61 and 64 to which a dielectric layer (Fig 15B passivation item) is applied to the surfaces of each mesa structure exposed by the etch treatment, and wherein said dielectric layer has openings to allow the application of metal contacts (22).

25. Regarding claims **67 and 69**, Taylor discloses a photo-detector according to claims 33 and 50, in which the n-type or p-type doping in the barrier is concentrated in a very narrow delta doping layer (Fig 12A) located at the junction with the photon absorbing layer.

26. Regarding claims **71 and 73**, Taylor and Elliot discloses the detector of claims 33 and 50. The language “wherein said layer materials are selected such that when biased with an externally applied voltage, the bands in the photon absorbing layer next to the barrier layer are flat or accumulated, such that a depletion region exists only in the barrier and contact layers but not in the photon absorbing layer, and a conduction band edge in any part of the photon absorbing layer lies above a conduction band edge in any part of the contact layer and does not lie more than $10kT_{op}$ below the conduction band edge in any part of the barrier layer, where k is the Boltzman constant and T_{op} is the operating temperature” describe an intended use of the device.

27. Intended use and other types of functional language must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the

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prior art. In re Casey, 152 USPQ 235 (CCPA 1967); In re Otto, 136 USPQ 458, 459 (CCPA 1963). In this case the device taught by Taylor and Elliot, having a similar structure to that claimed, is capable of performing the intended use. Furthermore, Taylor recites that bias voltages are tuned and/or varied in order to change the device response (col 10 ln 40-46) and also that changing the bias voltage drives the depletion region to different depths in layer 16 (corresponding to the heterojunction as claimed, as taught by Elliot).

28. Claims **43, 47, 49, 55 and 59** are rejected under 35 U.S.C. 103(a) as being unpatentable over Taylor, Elliot and Johnson (IDS filed 24 Sept. 2007, Journal of Applied Physics, volume 80, pages 1116 – 1127), hereinafter Johnson.

29. Regarding claim **43**, Taylor and Elliot discloses the detector of claim 34, but does not specify wherein the photon absorbing layer is a type II superlattice (SLS) material which comprises alternating sub-layers of $\text{InAs}_{1-w}\text{Sb}_w$ and $\text{Ga}_{1-x-y}\text{In}_x\text{Al}_y\text{Sb}_{1-z}\text{As}_z$ wherein $0 \leq w \leq 1$, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$ and $x + y < 1$ and wherein the sub-layers each have a thickness in the range of 0.6-10 nm.

30. Johnson discloses in a similar device that a photon absorbing layer may comprise an SLS of $\text{InAs}/\text{GaInSb}$, which is a suitable alternative to the SLS materials claimed (see Taylor, col 8 ln 21-34). The SLS structure is beneficial for its lower dark currents and enhanced lifetime (Johnson, page 1116 col 2 ln 1-5). Each sublayer is in the range of 0.6-10nm (Johnson page 1118 col 2 last paragraph). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the teachings

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of Johnson in order to lower the dark current and enhance the lifetime of the detector.

Furthermore, one of ordinary skill in the art would have been motivated to look to analogous art teaching alternative suitable materials, art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

31. Regarding claims **47 and 55**, Johnson teaches that the n-type photon absorbing layer (SLS) is terminated by a highly doped terminating layer (Fig 3, N+ GaSb layer 8×10^{17}) with a thickness of $1 \mu\text{m}$, in order to lower resistance for the external contact (page 1121 col 1 paragraph 2). Taylor discloses that the layers may be of opposite conductivity type. The language, "the valence band edge of the highly doped terminating layer lies below that in the next photon absorbing layer" describes an intended use of the photo-detector.

32. Regarding claims **49 and 59**, Taylor discloses in Fig 5 photo-detector comprising stacked detector sub-units as in claim 47 in which each detector sub-unit has a different cut-off wavelength (col 9 ln 6) and in which each detector sub-unit is separated from its neighboring sub-unit by a p-type GaSb layer (18, col 8 ln 28) to which an external contact (24) is made and is connected to a silicon readout circuit by an indium bump (22A, 22B).

Allowable Subject Matter

33. Claims **45, 68 and 70** are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

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34. The following is a statement of reasons for the indication of allowable subject matter: the prior art does not disclose or make obvious the photo-detector according to claim 45, including wherein the contact layer is a type II superlattice comprising alternating sub-layers of $\text{InAs}_{1-w}\text{Sb}_w$ and $\text{Ga}_{1-x-y}\text{In}_x\text{Al}_y\text{Sb}_{1-z}\text{As}_z$ with $0 \leq w \leq 1$, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$ and $x + y < 1$ and wherein the sub-layers have a thickness in the range of 0.6-10 nm. The prior art also does not disclose or make obvious the photo-detector according to claims 68 and 70, including wherein the p-type δ -doping layer has $5 \times 10^{10} \text{ p} < 10^{12} \text{ acceptors cm}^{-2}$.

Response to Arguments

35. Applicant's arguments with respect to claims 33-37 and 39-52, 55-73 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

36. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOHN C. INGHAM whose telephone number is (571)272-8793. The examiner can normally be reached on M-F, 8am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Wai-Sing Louie/
Primary Examiner, Art Unit 2814

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